WHAT OUR INSECT ENEMIES CAN LOOK FOR

Talk by Dr. Byron T. Shaw, Administrator, Agricultural Research Service, U. S. Department of Agriculture, at the dedication of the Southern Grain Insects Research Laboratory, Tifton, Georgia, June 26, 1962

I am glad to have this opportunity to take part in dedicating the Southern Grain Insects Research Laboratory here at Tifton.

To me, this laboratory is an expression of faith in the future -- the future of research . . . the future of agriculture . . . and, indeed, the future of our country. Let me tell you why.

Insects have long been man's greatest enemy. They were a force on this earth for millions of years before man arrived, and some people have suggested that insects will be around long after he is gone.

Only last week, a Washington paper carried this headline: "Scientists See A-War Killing All But Bugs." A well-known geneticist has warned the first National Conference of Scientists on Survival that lethal doses of radiation from a nuclear attack would erase most of this Nation's plant and animal life. Only insects and bacteria, he said, are "fitted for survival in the nuclear age."

There are many of us who have faith that man will not only save himself from nuclear destruction but also go on to survive the insect menace. The dedication of this laboratory shows that we expect research in entomology to help develop an even stronger agriculture to undergird the Nation.

As you can see, I feel confident about the future. And yet, I would not want to suggest that we can look for an easy victory in our war with insects. Anyone who doubts that we face a formidable foe need only look about the United States today:

The boll weevil infests two-thirds of our cotton acreage and causes an annual loss of $300 million. This pest now threatens to invade the arid Southwest, where extra-long-staple Pima cotton is grown. This cotton is extremely susceptible to the ravages of the boll weevil.

The European corn borer is spreading farther south and west every year and now feeds on corn and many other crops in 39 States. It costs American farmers about $100 million a year.

Insects kill more of our forest trees than weather, disease, or fire. In addition, the growth of surviving trees is seriously reduced by insects. They

destroy enough timber every year to build a million homes.

The face fly is rapidly becoming a serious menace to our livestock. By constantly attacking the eyes of animals as they graze, this pest reduces milk production in dairy cows and holds down weight gains in beef cattle.

Only through stringent quarantines and intensive control measures, have we been able to hold the Japanese beetle in the East over the last 40 years. This insect has a taste for well over 200 plants. Its advance into the major agricultural area of the country could be disastrous.

The imported fire ant has become a major pest in nine southern States and is a potential threat to the entire South. Its hard-crusted mounds reduce pasture production and damage farm machinery. It damages a variety of crops and may even kill young animals. Its venomous sting interferes with field work and makes the fire ant a serious health hazard.

The insect most feared by fruit and vegetable growers throughout the world is the Mediterranean fruit fly. It ruins the fruit of a hundred different crops. Within the last two weeks, the Medfly has invaded the United States -- in the Miami area -- for the third time. Fortunately, because of research on methods of detection and control, our Federal and State regulatory workers are prepared to deal with it.

But I need not go further in this sampling of the 10,000 different insect pests that plague us. You could name a host of others. No plant or animal escapes the threat of insect attack. Corn alone is hit by almost 400 different insects from field through storage.

Total losses from insects in the United States amount to $4 billion a year, including control costs. And it's only by conducting research and by spending hundreds of millions of dollars on controls that we keep losses from being many times what they are.

Thus, insects continue to be a tremendous problem in this country. Why is this so?

Part of the answer is to be found in the way our highly productive agriculture has developed. We could harly have arranged things better for the insects. Millions of acres of rank, high-yielding crops provide everything a plant pest needs in the way of food and shelter.

We introduce new plants from around the world, as well as breed new varieties of crops, and both of them sometimes appeal to our native insects. At the same time, many foreign insects have accidentally been brought into this country, where they often find desirable climate and hosts but few natural enemies.

Although we have greatly improved our quarantine measures, we have also developed high-speed transportation systems that can spread pests from continent to continent . . . from one part of the country to another . . . in a matter of hours.

There's no question but what we have done some favors for our insect enemies. But the main reason they have become such vicious competitors is to be found in the remarkable capabilities of the insects themselves.

For one thing, their ability to reproduce is fantastic. A single pair of insects can, within a few generations, produce millions of offspring.

Even more fantastic, perhaps, is insects' ability to survive. They live in all sorts of places. They eat all sorts of things -- and some can go for years without eating. But most important of all, insects adapt to unfavorable conditions. Through changes in their genetic makeup, over a hundred species are now managing to survive our most powerful insecticides. And the tough, new strains are multiplying as vigorously as ever. All in all, it certainly looks as though insects are here to stay!

Considering the caliber of this opposition, I think we've done well in the fight against insects. If we hadn't, American farmers wouldn't be producing the way they are today. We have developed some sort of control measure for nearly every kind of pest we face.

But these advances are not good enough, and people are looking to us to find more effective and efficient ways to combat insects.

Of course, there are a few people who say that what we ought to do is abandon our control measures and restore what they call "the balance of nature." If we'd just let nature take its course, so they say, we wouldn't have to worry about these serious problems with insects.

But what is this balance of nature they speak of? Is it the balance of two or three centuries ago, when this whole country supported less than a million Indians? Is it the balance of a hundred years ago, when one American farmer barely produced enough to feed five other people? Or is it the balance we still find today in some underdeveloped countries, where the population just manages to exist in miserable poverty?

I can't believe that anyone seriously wants to go back to something like that. Nature's balance permits more damage than our society would be willing to tolerate.

Science and technology have enabled us to achieve a man-made balance of nature at a high level in the United States. We can push this balance still higher by making a determined research attack on such production hazards as insects.

Most of the insect-control measures we now use involve chemicals. But this heavy reliance on chemicals has created some problems:

A growing number of insects are acquiring resistance to the insecticides used on them. Then, too, there has been increasing public pressure to control insects without leaving any residues of these chemicals. And we have become more and more concerned about possible damage to bees and other beneficial insects.

In spite of these problems, chemicals are undoubtedly going to be our most dependable weapon against agricultural pests for some time to come. We could not produce enough high-quality food without them.

We feel, however, that there are opportunities to overcome the objections to conventional chemicals and, at the same time, improve their efficiency.

We are looking for new types of chemicals that will be highly specific against agricultural pests but not harmful to man, animals, or useful insects. We are making progress on systemic insecticides that work within a plant and thus do not contaminate the outside environment. And we are, of course, putting a lot of effort into developing new chemicals that will enable us to keep ahead of resistant insects.

But these chemicals that <u>kill</u> are only part of the story of chemical control -- some other approaches are even more interesting.

Take attractants, for example. Insects, to survive, respond to certain vital natural attractants: their food supply . . . the opposite sex . . . and host plants or animals on which to reproduce. It's easy to see how we may be able to take advantage of this fact in both detection and control. For example, by combining attractants with poison baits and placing them near but not on the crops, we could kill insects without leaving residues at all. Attractants have already proved highly successful against the gypsy moth and the Medfly, and we are investigating other possibilities.

There is also great promise in developing chemicals that will <u>sterilize</u> insects rather than kill them. The idea takes a little getting used to, but the fact is that a sterile insect is better than a dead one. If you <u>kill</u> 90 percent of an insect population, the remaining 10 percent can continue to reproduce and rebuild the numbers. But if you <u>sterilize</u> 90 percent of the insects, only 1 percent should reproduce.

This principle might be applied in two ways. We might raise insects on artificial media, sterilize them with chemicals, and release them in large quantities to overwhelm the natural population. Or we might combine the chemosterilant with an attractant to give the natural population a do-it-yourself sterilization right in the field!

We have some encouraging leads in our search for effective chemosterilants. Incidentally, our findings may also have implications for human medicine. There seems to be a correlation between the sterilizing chemicals and those that are most promising for treating certain types of cancer.

We know the sterility idea will work, because it was this same principle that we used in carrying out the spectacular screwworm eradication campaign in the Southeast three years ago. In that case, we used gamma rays from cobalt 60 to sterilize the flies. A similar campaign is now underway in the Southwest.

I regard the sterile-male concept of insect eradication as one of the really original scientific ideas of this century.

We are directing more and more of our research efforts to the development of control methods that get completely away from chemicals.

Another good prospect lies in taking better advantage of nature's control forces. Every insect has parasites, predators, and diseases that limit its increase. Without their help, we would face a hopeless task in trying to protect our crops and livestock.

Although we can't rely on these natural forces alone for dependable control, we can learn to supplement nature in such a way as to get results. For example, we might be able to produce an insect disease in quantity and spray it like an insecticide. Already, more than a hundred insect parasites and predators have been established on about 40 different pests in the United States.

The most nearly ideal approach to reducing insect losses is to develop plant varieties that resist insect attack. This involves no extra cost to the grower and has no hazards. It has been effective in dealing with a number of pests, and we are devoting more effort to this work.

As we move into all these broad areas, we find that we don't have enough basic information on insects either to fully appraise the potential of the new approaches or to develop them for practical use.

For example, to use the sterile-male technique effectively, we need to know a great deal more about the habits of insects in their natural environment -- their population density . . . the factors that regulate their rate of increase . . . why they disperse and how.

The story is much the same in every area.

To carry on research like this, we need modern laboratories, good equipment, and well-trained scientists. I am happy to say that we have all of these here at the Southern Grain Insects Research Laboratory.

The site furnished by the State of Georgia is located in one of the best farming areas in the South. And we are fortunate to be joining the stimulating scientific community at Georgia's excellent Coastal Plain Experiment Station. I am confident that this relationship will prove valuable to both of us in the work ahead.

The research at this laboratory will be a team effort, because we expect our explorations to lead into many complex areas. We are focusing here the capabilities of scientists trained not only in entomology but also in plant genetics, plant physiology, biochemistry, and engineering.

They will give attention to our current difficulties with grain insects -- but they will also look to the future through basic studies that may well yield concepts we can't even envision today.

I want to mention briefly just a few of the challenges they face.

One of our goals is to develop varieties of corn, sorghum, and grain that are resistant to insect damage.

You'd naturally expect resistance to the corn earworm to be one of our main concerns. This pest is found in every State and is the most important corn insect in the South as well as in the Northeast and West. It also feeds on more than a hundred other crops under such aliases as the cotton bollworm and the tomato fruitworm.

Research over the years has developed corn with a high degree of earworm resistance. But this isn't good enough -- especially in sweet corn, where one small worm or even a few damaged grains cause an ear to run into buyers' resistance in the supermarket.

The earworm resistance we have seems to be due to a number of factors. Tight husk is one. Then, we have found in the silks of a few sweet corns an inheritable factor that is lethal to earworm larvae. And some other sweet corns seem to have nutritive qualities that speed up the maturing and emergence of earworms from the ear before they have done much damage.

We need to learn more about the source of this resistance. If it turns out to be chemical in nature, we might be able to develop a chemical test that would quickly tell breeders whether or not a prospective variety was going to measure up.

Corn with resistance to the rice weevil is another good possibility. Although this pest does most of its damage after corn is stored in the crib, the infestation often starts in the field. Some varieties now have considerable weevil resistance, which seems to be related to the coverage at the end of the ear.

We also hope to develop sorghum varieties that are resistant to the sorghum midge and sorghum webworm, pests that seriously damage the heads. But we have no leads so far. Our scientists must start from the beginning on this one.

Another promising source of measures for combating southern grain insects is biological control. For the present, our major efforts will be on diseases, particularly those of the corn earworm. We know that there are a number of bacterial, fungus, and virus diseases of this pest -- so many, in fact, that it's hard to grow earworms in the laboratory. But we haven't yet gone far enough to isolate and study these diseases.

We have many tasks in the area of chemicals. One will be to screen and field-test new chemicals that seem to have possibilities for controlling specific corn insects with safety. As you know, DDT residues are now a serious obstacle to the use of silage and fodder in feeding dairy and beef animals.

Research on residues will include studies to determine the amount of residues that occur in grain and the disappearance rate of the chemicals. This is especially important in the case of sorghum which, unlike corn, has no husk to protect the grain.

The engineers are trying hard to improve our methods of applying chemicals safely and efficiently. I hope they can work out a way to put just a little insecticide on that small spot of silk at the tip of each ear of corn!

Our initial efforts on developing attractants will be devoted to searching for sexual attractants for the corn earworm and the fall armyworm.

We are now looking into the possibility of using the sterile-male technique against the corn earworm and the fall armyworm, both of which overwinter in the South. By rearing and releasing overwhelming numbers of sterilized insects, we might be able to wipe out small populations of these pests as they move north early in the season. Our work so far indicates that sterilization with cobalt 60 tends to deform the moths, so chemosterilants may offer greater promise. We do have some chemicals that will work, and we are following up on these encouraging leads.

Perhaps our greatest need in all of this work is for more fundamental knowledge of the insects and their habits. In the past, for example, we have studied the corn earworm on one crop or another. We must view this pest in its total environment.

In addition, we must learn how to raise these insects in the laboratory the year round. Most of them are now available to our scientists only for brief periods during the summer months..

All together, we will work on about a dozen and a half of the insects that are most troublesome in this region today. I am confident that the opening of this laboratory will mark a significant turning point in the South's struggle with grain pests.

The work here is, of course, part of a nationwide program of agricultural research conducted by USDA and many cooperators. Research has been one of the most important concerns of the U. S. Department of Agriculture and the Nation's Land-Grant Colleges since their founding a century ago. In their research achievements lies the force that has shaped America's agriculture and opened the way for the development of our industrial economy.

I hope that we will resolve, in this centennial year, to make sure that agricultural research continues as a vigorous, revolutionary force serving all our people in the critical hundred years ahead.

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